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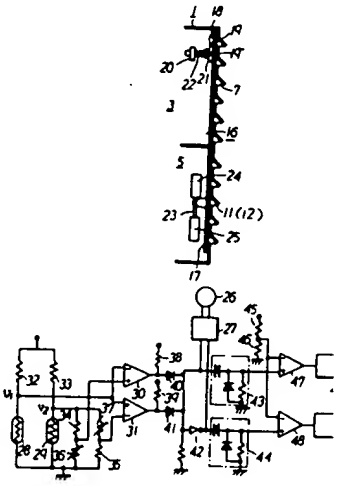
(JA '338)

(54) VENTILATING FAN WITH HEAT EXCHANGER
(11) 57-55338 (A) (43) 2.4.1982 (19) JP
(21) Appl. No. 55-130467 (22) 18.9.1980
(71) SHARP K.K. (72) KIMIO NAKAGAWA
(51) Int. Cl³. F24F7/08



PURPOSE: To reduce a pressure loss and save an eectrical energy with a ventilating operation being performed except a cooling/heating operation time by a method wherein a heat exchanging ventilation passing through a heat exchanger in the ventilation fan and a normal ventilation not passing through the heat exchanger are changed over automatically in response to a difference in temperature between the in-door and out-door temperatures.

CONSTITUTION: Resistance value of the in-door temperature sensor 28 is made to be lower than that of an out-door temperature sensor 29 whdn the in-door temperature is higher than the out-door temperature under a heating condition, and the terminal voltages V_1, V_2 are made to show a relation of $V_1 < V_2$. When the difference in voltages is exceeded over a predetermined value, the output value of the comparator 30 becomes a value of H. In turn, when cooled, the relation between V_1 and V_2 shows $V_1 > V_2$ and subsequently when the difference in voltages becomes more than a predetermined value, the output of the comparator 31 becomes a value of H. In this way, when the output of either one of the comparators 30, 31 becomes a value of H, the switching unit 27 causes each of the motors 26 for suction and exhaust fans to be rotated at a high speed. And the solenoid 25 is energized by a driver circuit 49, the ventilation holes 11, 12 are released to open by a downward movement of the shutter 17 to cause a heat exchanging ventilation condition.

indoor (T) = 28
outdoor (T) = 29

in heating mode if $T_{indoor} > T_{outdoor}$ by some value. [illegible]

H

⑲ 日本国特許庁 (JP)　　⑪ 特許出願公開

⑫ 公開特許公報 (A)　　昭57—55338

⑤1Int. Cl.³　識別記号　庁内整理番号　⑬公開 昭和57年(1982)4月2日
F 24 F 7/08　6438—3L

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審査請求 未請求

(全 4 頁)

⑤4熱交換型換気扇

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⑳特願 昭55—130467
㉒出願 昭55(1980)9月18日

明細書

1. 発明の名称

熱交換型換気扇

2. 特許請求の範囲

1. 熱交換器を含む吸・排気通路と、吸・排気を強制的に行なう送風機とを具備し、吸・排気通路を通過する室内・外空気間で熱交換させるものにおいて、熱交換器を含まない吸・排気補助通路を設けると共に、吸・排気通路と吸・排気補助通路とを切換える通路切換手段を設け、この通路切換手段を、室内外の温度差に応じて切換制御する制御手段を備えたことを特徴とする熱交換型換気扇。

2. 熱交換器を含む吸・排気通路と、吸・排気を強制的に行なう送風機とを具備し、吸・排気通路を通過する室内・外空気間で熱交換させるものにおいて、熱交換器を含まない吸・排気補助通路を設けると共に、吸・排気通路と吸・排気補助通路とを切換える通路切換手段を設け、この通路切換手段及び送風機の回転速度を、室内外の温度差に応じて切換制御する制御手段を備えたことを特徴とする熱交換型換気扇。

3. 発明の詳細な説明

本発明は強制吸排気により室内の換気を行なう換気扇に係り、特に熱交換器を具備し、排気される室内空気の熱エネルギーを吸気する室外空気との熱交換により回収して、熱エネルギーの損失を極力少なくできるようにした熱交換型換気扇に関するものである。

一般に、この種の熱交換型換気扇にあつては、常に熱交換器を通して吸排気を行なう構造である為、冷・暖房時以外の換気時にも熱交換器を通して吸排気を行なうことになり、このような場合室内外の温度差が零若しくは極わずかであつて、回収できる熱エネルギーも零若しくは極わずかであるにも拘わらず、熱交換器を通すことにより熱交換器による圧力損失分送風エネルギーが損失することになり、総合的に見て大きなエネルギーの損失となつている。

本発明はかかる点に鑑みてなされたもので、室

内外の温度差に応じて熱交換器を通す熱交換換気と熱交換器を通さない通常換気とに自動的に切換わるように構成し、総合的に見て常にエネルギーの無駄を少なくして換気運転を行なえるようにしたものである。以下図面に示した本発明の実施例について詳細に説明する。

先ず第１図及び第２図において、１は箱状の換気扇本体で、内部に隔壁２を十字形状に配設することにより室内外方向に延びる４つの通路３～６を区画形成する。左・右上部通路３、４は共に室外側端をスリット状の通気口７、８に、室内側端を通気口９、１０に夫々形成し、又左・右下部通路５、６は共に室外側端をスリット状の通気口１１、１２に形成しかつ室内側端を閉塞端としている。

１３は換気扇本体１に内装され、各通路３～６に跨つて位置する熱交換器で、内部を介して左上部通路３と右下部通路６とを連通すると共に右上部通路４と左下部通路５とを連通している。１４、１５は左・右上部通路３、４において熱交換器13より通気口９、１０側に位置する吸・排気用送風機で、単一の電動機により同時に回転駆動され、強制的に吸排気を行なうものである。

１６は左・右上部通路３、４の通気口７、８と左・右下部通路５、６の通気口１１、１２とを選択的に開放する通路切換手段で、シャッター１７、係止機構及び上下作動機構等により構成される。上記シャッター１７は多数のスリットを有する板体からなり、通気口７、８、１１、１２の内面側に上下摺動自在にあつて、上下摺動により通気口７、８側と通気口１１、１２側とを選択的に開放するよう構成してある。又、係止機構はシャッター１７に取着され上下に離間した２個の係止部１９、１９'を有する係止体１８と、換気扇本体１内面の軸受２０に移動自在に支持され係止部１９、１９'に係脱する係合ピン２１と、該ピン２１を常時係合方向に付勢するスプリング２２とからなり、係合ピン２１が係止部１９に係合した時下方位置（通気口１１、１２の開放位置）に、係止部１９'に係合した時上方位置（通気口７、８の開放位置）に夫々シャッター１７を係止保持するものである。上下作動機構はシャッター１７に連結するプランジャー２３と、通電時プランジャー２３を吸引してシャッター１７を上動させる上動用ソレノイド２４と、通電時プランジャー２３を吸引してシャッター１７を下動させる下動用ソレノイド２５とからなり、シャッター１７を係止機構に抗して強制的に上動又は下動するものである。

而して、上述構造にあつてはシャッター１７が下方位置（通気口１１、１２の開放位置）にある時通気口１２から右下部通路６、熱交換器１３、左上部通路３を経て通気口９に至る吸気通路と、通気口１０から右上部通路４、熱交換器１３、左下部通路５を経て通気口１１に至る排気通路とが形成され、又シャッター１７が上方位置（通気口７、８の開放位置）にある時通気口７から左上部通路３を経て通気口９に至る吸気補助通路と、通気口１０から右上部通路を経て通気口８に至る排気補助通路とが形成されるものである。

次に、送風機１４、１５用電動機の回転速度及び通路切換手段１６を切換制御する制御手段について第３図の電気回路図と共に説明する。第３図において、２６は吸・排気用送風機１４、１５を回転駆動する電動機、２７は入力信号に基いて電動機２６の回転速度を切換制御するスイッチング部、２８は室内温度を感知する負特性サーミスタからなる室内側感温素子、２９は室外温度を感知する負特性サーミスタからなる室外側感温素子、３０、３１はコンパレータ、３２～３５は抵抗、３６、３７は抵抗値を任意に設定することにより室内外の温度差が所定の値に達した時コンパレータ３０、３１にＨｉレベルの出力を得られるようにする可変抵抗、尚コンパレータ３０、３１の出力は抵抗３４～３７により同時にＨｉレベルにならないよう設定されている。３８、３９は抵抗、４０、４１はダイオード、４２はインバータ、４３、４４は微分回路、４５、４６は抵抗、４７、４８は波形整形のためのパルス発生部、４９、５０はソレノイド２５、２４のドライバ回路である。

而して、上述実施例にあつては熱交換器１３に

より回収できる熱エネルギーが熱交換器１３により損失する送風エネルギーを上回わる温度差が、室内外温度間に生じた時コンパレータ３０、３１の出力がＨｉレベルになるよう可変抵抗３６、３７を設定してある。又、電動機２６の回転速度は高速と低速との二段階に切換えられ、低速時の回転速度は熱交換器１３を通さずに送風した際必要換気風量を得られる値に、高速時の回転速度は熱交換器１３を通して送風した際必要換気風量を得られる値に夫々設定してある。

次に、その動作について説明する。暖房時室内温度が室外温度より高い状態にあつて、室内側感温素子２８の抵抗値は室外側感温素子２９の抵抗値より小さく、その端子電圧 V_1 も端子電圧 V_2 より小さくなつている。そして、室内外の温度差が所定の値まで拡がると、コンパレータ３０の出力がＨｉレベルになる。即ち、抵抗３４の抵抗値を R_1、可変抵抗３６の抵抗値を R_2 とした場合、$V_1 < \frac{R_2}{R_1+R_2} V_2$ の関係になると、コンパレータ30の出力がＨｉレベルになる。

又、冷房時室内温度が室外温度より低い状態にあつて、室内側感温素子２８の抵抗値は室外側感温素子２９の抵抗値より大きく、その端子電圧 V_1 も端子電圧 V_2 より大きくなつている。そして、室内外の温度差が所定の値まで拡がると、コンパレータ３１の出力がＨｉレベルになる。即ち、可変抵抗３７の抵抗値を R_3、抵抗３５の抵抗値を R_4 とした場合 $V_1 > \frac{R_4}{R_3+R_4} V_2$ の関係になると、コンパレータ３１の出力がＨｉレベルになる。

上述の如くコンパレータ３０或いは３１の何れかの出力がＨｉレベルになると、スイッチング部２７は入力信号に基づいて電動機２６を高速運転すると共に、ドライバ回路４９は微分回路４３、パルス発生部４７を通つて信号が入力されることによりソレノイド２５を短時間動作させる。すると、ソレノイド２５はプランジャー２３を吸引してシャッター１７を下動させ、通気口１１、１２を開放する。

然るに、このような状態では通気口１２から右下部通路６、熱交換器１３、左上部通路３を経て通気口９に至る吸気通路を介し室外空気を強制的に吸気すると同時に、通気口１０から右上部通路４、熱交換器１３、左下部通路５を経て通気口11に至る排気通路を介し室内空気を強制的に排気することになり、室内外空気間の熱交換と共に室内の換気が行なわれる。このような熱交換換気は、熱交換器１３を通す為、該熱交換器１３による圧力損失分送風エネルギーを損失することになるが、回収できる熱エネルギーの方が大きく、総合的に見てエネルギーに無駄なく換気できることになる。

冷・暖房時以外の時には室内外の温度差が零かこれに近い値にあつて、両感温素子２８、２９の抵抗値及び端子電圧にも差がなく、コンパレータ３０、３１の出力は何れもＬｏレベルにある。すると、インバータ４２の出力によりスイッチング部２７は電動機２６を低速運転させ、又ドライバ回路５０は微分回路４４、パルス発生部４８を通つて入る信号によりソレノイド２４を短時間動作させる。すると、ソレノイド２４はプランジ－23を吸引してシャッター１７を上動させ、通気口７、８を開放する。

然るに、このような状態では通気口７から左上部通路３を経て通気口９に至る吸気補助通路を介し室外空気を強制的に吸気すると同時に、通気口１０から右上部通路４を経て通気口８に至る排気補助通路を介し室内空気を強制的に排気することになり、室内の通常換気が行なわれる。

このような通常換気は熱交換器１３を通さない為該熱交換器１３による送風エネルギーの損失がなくなり、室内空気を熱交換することなく排気するも、総合的に見てエネルギーの無駄が少なくなる。又、吸・排気用送風機１４、１５即ち電動機２６の低速運転により必要換気風量を得ることができるので、熱交換換気時に比べて電動機２６の消費電力が少くなり、エネルギーの節約を行なえる。

上述の如く本実施例にあつては室内外の温度差に応じて熱交換換気と通常換気とに自動的に切換わり、総合的に見て常にエネルギーの無駄を少なくして換気できるものである。

尚、全熱交換を行なう場合、室内外のエンタルピー差に応じて熱交換換気と通常換気とを切換えるようにすればよい。但し、室内外のエンタルピー差は直接検出できない為、空気線図においてエンタルピーと略平行関係にある湿球温度を利用し、室内外の湿球温度差を検出することで代用する。

又、本発明において通路切換手段及び制御手段は上述実施例のものに限定されるものではない。

以上の如き本発明によれば、室内外の温度差に応じて熱交換換気と通常換気とに自動的に切換え、総合的に見て常にエネルギーの損耗を少なくして換気することができ、エネルギーの節約上頗る有益なものである。

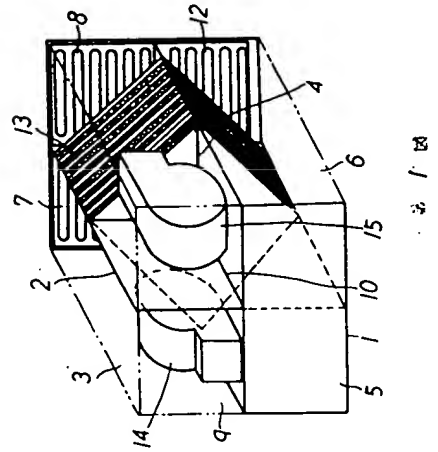
さらに、通常換気時吸排気を行なう送風機の回転速度を低速に切換えることにより、必要換気風量が得られる上に、送風機の消費電力を少なくでき、より好ましいものになる。

4. 図面の簡単な説明

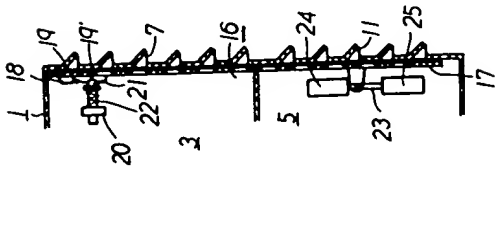
第1図は本発明換気扇の概略構成図、第2図は同上通路切換手段を示す断面図、第3図は同上電気回路図である。

3～6：通路、7～12：通気口、13：熱交換器、14、15：送風機、16：通路切換手段、17：シャッター、24、25：ソレノイド、26：電動機、28：室内側感温素子、29：室外側感温素子。

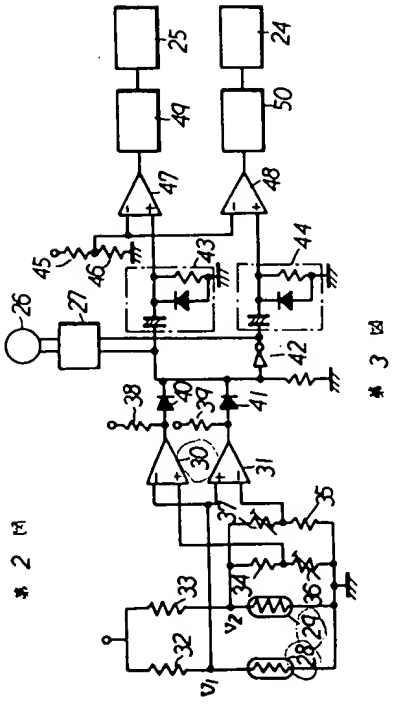
代理人　弁理士　福士愛彦



第1図



第2図



第3図

(19) Japanese Patent Office (JP) (11) Kokai Number

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(51) Int. Cl.[3] F 24 F 7/08 Classif. No. JPO No. 6438-3L

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(54) Title of the Invention: Ventilating Fan with Heat Exchanger
(21) Application No.: S55-130467
(22) Date Application Filed: September 18, 1980 (Showa 55)
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* Publication of unexamined patent application

SPECIFICATION

1. Title of the Invention

VENTILATING FAN WITH HEAT EXCHANGER

2. Scope of Claims

1. A ventilating fan with heat exchanger, characterized by being equipped with an air intake and exhaust passage, which includes a heat exchanger and a blower for forcibly taking in and expelling air; comprising in a portion that causes heat exchange between the indoor and outdoor air passing through the air intake and exhaust passage:

an auxiliary air intake and exhaust passage without a heat exchanger and

a passage switching means for switching between the air intake and exhaust passage and the auxiliary air intake and exhaust passage: and

a controlling means for controlling the switching of the passage switching means according to the difference between the indoor and outdoor air temperatures.

2. A ventilating fan with heat exchanger, characterized by being equipped with an air intake and exhaust passage, which includes a heat exchanger and a blower for forcibly taking in and expelling air; comprising in a portion that causes heat exchange between the indoor and outdoor air passing through the air intake and exhaust passage:

- an auxiliary air intake and exhaust passage without a heat exchanger and
- a passage switching means for switching between the air intake and exhaust passage and the auxiliary air intake and exhaust passage; and

a controlling means for controlling the switching of the passage switching means and the rotational speed of the blower according to the difference between the indoor and outdoor air temperatures.

3. Detailed Description of the Invention

The invention, which involves the performance of indoor ventilation via forced intake and exhaust, relates to a ventilating fan with heat exchanger that is especially equipped with a heat exchanger, recovers the thermal energy of expelled indoor air by performing heat exchange between it and outdoor air, and minimizes the loss of thermal energy.

Generally, ventilating fans with heat exchangers of this class are constructed so that intake and exhaust is invariably performed via the heat exchanger. This necessitates ventilation through the heat exchanger even when an air conditioner or heater is not being used and the difference between the indoor and outdoor air temperatures lies at or near zero, meaning that the recoverable thermal energy is also

at or near zero. Nevertheless, blower energy is lost due to the pressure loss caused by the heat exchanger and, as a whole, a large amount of energy is lost.

The invention, which was made in consideration of the above points, is composed to allow automatic switching between heat exchange ventilation via the heat exchanger and normal ventilation without the use of the heat exchanger according to the difference between the indoor and outdoor air temperatures. As a whole, the invention enables ventilation to be performed while reducing wasted energy. The working examples of the invention shown in the drawings shall be described in detail.

First, in Figures 1 and 2, 1 is a box-shaped ventilating fan unit. Dividing walls 2 located within are arranged in a crossed configuration to form four passages 3 – 6, which extend between the inside and outside. The upper left and right passages 3 and 4 comprise slitted ventilation holes 7 and 8 on the outdoor end and ventilation holes 9 and 10 on the indoor end. The lower left and right passages 5 and 6 comprise slitted ventilation holes 11 and 12 on the outdoor end, with the indoor end being the closed end.

Item 13, contained within the ventilating fan unit 1, is a heat exchanger, which straddles the passages 3 – 6. The upper left passage 3 and the lower right passage 6 are connected via the inside of the heat exchanger. The upper right passage 4 and the lower left passage 5 are similarly connected. Within the upper left and right passages 3 and 4, intake and exhaust blowers 14 and 15 are located on the side of the ventilation holes 9 and 10 away from the heat exchanger 13. They are simultaneously rotated by a single motor to forcibly take in and expel air.

Item 16 is a means for passage switching, which selectively opens the ventilation holes 7 and 8 of the upper left and right passages 3 and 4 or the ventilation holes 11 and 12 of the lower left and right passages 5 and 6. It comprises a shutter

17, a latching mechanism and an up-and-down movement mechanism. The shutter 17 comprises a plurality of plates with slits, slides freely up and down within the ventilation holes 7, 8, 11, and 12 and is composed so that being slid up or down selectively opens the ventilation holes 7 and 8 or the ventilation holes 11 and 12. The latching mechanism is attached to the shutter 17 and comprises a latching unit 18 with two latches 19 and 19' separated vertically; a joining pin 21 that is supported in a freely rotatable manner by a receptacle 20 of the ventilating fan unit 1 and attaches and detaches from the latches 19 and 19'; and a spring 22, which continually applies force to the pin 21 in the direction, in which it is joined. When the joining pin 21 is joined to the latch 19, the shutter 17 is held latched in the downwards position (the position in which ventilation holes 11 and 12 are open) and, when it is joined to the latch 19', the shutter 17 is held latched in the upwards position (the position in which ventilation holes 7 and 8 are open). The up-and-down movement mechanism comprises a plunger 23 connected to the shutter 17; a solenoid 24 for upward movement which, when energized, pulls the plunger 23 and moves the shutter 17 upward; and a solenoid 25 for downward movement which, when energized, pulls the plunger 23 and moves the shutter 17 downward. This mechanism, in opposition to the latching mechanism, forcibly moves the shutter 17 upwards or downwards.

By virtue of the above configuration, when the shutter 17 is in the downwards position (the position in which the ventilation holes 11 and 12 are open), an air intake passage—from the ventilation hole 12 via the lower right passage 6, the heat exchanger 13 and the upper left passage 3 to the ventilation hole 9—and an air exhaust passage—from the ventilation hole 10 via the upper right passage 4, the heat exchanger 13 and the lower left passage 5 to the ventilation hole 11—are formed. Moreover, when the shutter 17 is in the upwards position (the position in which the ventilation holes 7 and 8 are open), an auxiliary air intake passage—from the ventilation hole 7 via the upper left passage 3 to the ventilation hole 9—and an auxiliary air exhaust passage—from the ventilation hole 10 via the upper right passage [4] to the ventilation hole 8—are formed.

Next, the means for controlling the rotational speed of the motor powering the blowers 14 and 15 and the means for controlling the switching of the passage switching means 16 will both be explained in reference to the electrical circuit diagram in Figure 3. In the Figure, 26 is a motor, which rotates the intake and exhaust blowers 14 and 15, 27 is a switching unit, which controls the switching of the rotational speed of the motor 26 based on input signals, 28 is an indoor-side temperature sensor comprising a negative temperature coefficient thermistor, which senses the indoor air temperature, 29 is an outdoor-side temperature sensor comprising a negative temperature coefficient thermistor, which senses the outdoor air temperature, 30 and 31 are comparators, and 32 – 35 are resistors. Items 36 and 37 are variable resistors that generate high-level output from the comparators 30 and 31 when the difference between the indoor and outdoor air temperatures reaches a set value determined by an arbitrarily set resistance value, but they are set so that the comparators 30 and 31 do not simultaneously output at a high level because of the resistors 34 – 37. Items 38 and 39 are resistors, 40 and 41 are diodes, 42 is an inverter, 43 and 44 are differential circuits, 45 and 46 are resistors, 47 and 48 are pulse emitters for generating waveforms and 49 and 50 are driver circuits for the solenoids 25 and 24.

In the above working example, the variable resistors 36 and 37 are set to increase the output of the comparators 30 and 31 to a high level (that is, they go "high") in the event a difference between the indoor and outdoor air temperatures arises, so that the amount of recovered thermal energy by the heat exchanger 13 exceeds the blower energy lost due to the heat exchanger 13. Moreover, the rate of rotation of the motor 26 can be set at one or two speeds—a low and high speed. The rate of rotation at the low speed is set to a value allowing ventilation of the necessary amount of air without passing it through the heat exchanger and the rate of rotation at high speed is set to a value allowing ventilation of the necessary amount of air through the heat exchanger 13.

Next, the actions of the invention will be described. When the room is heated so the indoor air temperature is higher than the outdoor air temperature, the amount of resistance of the indoor-side temperature sensor 28 is less than this value for the outdoor-side temperature sensor 29, and the terminal voltage V_1 is less than the terminal voltage V_2. Once the difference between the indoor and outdoor air temperatures increases to a certain value, the output of the comparator 30 reaches a high level. In greater detail, given that R_1 is the resistance of the resistor 34 and R_2 is the resistance of the variable resistor 36, the comparator 30 outputs at a high level when:

$$V_1 < \frac{R_2}{R_1 + R_2} V_2$$

When the room is air conditioned, so the indoor air temperature is lower than the outdoor air temperature, the amount of resistance of the indoor-side temperature sensor 28 is greater than this value for the outdoor-side temperature sensor 29, and the terminal voltage V_1 is greater than the terminal voltage V_2. Once the difference between the indoor and outdoor air temperatures increases to a certain value, the comparator 31 outputs at a high level. In greater detail, with R_3 being the resistance of the variable resistor 37 and R_4 being the resistance of the resistor 35, the comparator 31 begins outputting at a high level when:

$$V_1 > \frac{R_4}{R_3 + R_4} V_2$$

As has been explained above, when either the comparator 30 or the comparator 31 outputs at a high level, the switching unit 27 sets the motor 26 to high-speed operation based on input signals, and signals are input into the driver circuit 49 via the differential circuit 43 and the pulse emitter 47. This causes the solenoid 25 to operate for a short time. When this happens, the solenoid 25 pulls the plunger 23

downwards, which moves the shutter 17 downwards and opens the ventilation holes 11 and 12.

With the device in this configuration, outdoor air is forcibly taken in via the air intake passage, which runs from the ventilation hole 12 through the lower right passage 6, the heat exchanger 13 and the upper left passage 3 to the ventilation hole 9. Simultaneously, indoor air is forcibly expelled via the air exhaust passage, which runs from the ventilation hole 10 through the upper right passage 4, the heat exchanger 13 and the lower left passage 5 to the ventilation hole 11. Thereby, heat is exchanged between the indoor and outdoor air and the interior is ventilated. In such heat exchange ventilation, air is passed through the heat exchanger 13, so blower energy is lost due to the pressure loss caused by the heat exchanger 13, but the recovered thermal energy is greater than this, so ventilation without overall energy waste is possible.

When an air conditioner or heater is not being used, the difference between the indoor and outdoor temperatures stands at or about zero, so there is no difference between the resistance values or terminal voltages of the temperature sensors 28 and 29, and the output from both the comparators 30 and 31 is at a low level. Therefore, the switching unit 27, with the output of the inverter 42, causes the motor 26 to operate at a low speed, and the driver circuit 50 causes the solenoid 24 to operate for a short time with the signals coming through the differential circuit 44 and the pulse emitter 48. When this happens, the solenoid 24 pulls the plunger 23, causing the shutter 17 to move upwards, and the ventilation holes 7 and 8 are opened.

With the device in this configuration, outdoor air is forcibly taken in via the auxiliary air intake passage, which runs from the ventilation hole 7 through the upper left passage 3 to the ventilation hole 9. Simultaneously, indoor air is forcibly expelled through the auxiliary air exhaust passage, which runs from the ventilation

hole 10 through the upper right passage 4 to the ventilation hole 8. Normal indoor ventilation is thereby conducted.

In such normal ventilation, air is not passed through the heat exchanger 13, so the blower energy lost due to the heat exchanger 13 is eliminated and the indoor air is expelled without heat exchange. In this case too, wasted energy is reduced overall. Moreover, the necessary amount of air can be exchanged with the intake and exhaust blowers 14 and 15—or in other words, the motor 26—operating at a low speed. Therefore, the electrical power consumed by the motor 26 is lower than that used during heat exchange ventilation, so energy is conserved.

As has been explained above, heat exchange air ventilation and normal air ventilation are automatically switched between according to the difference between the indoor and outdoor air temperatures in this working example. Overall, ventilation can be conducted while wasted energy is reduced.

Heat exchange ventilation and normal ventilation should be switched between according to the difference in the indoor and outdoor enthalpy when total heat exchange is conducted. The difference in the indoor and outdoor enthalpy cannot be directly determined. But as enthalpy and wet bulb temperature run nearly parallel, indoor and outdoor wet-bulb temperatures could be measured instead.

Moreover, the passage switching means and the control means in the invention are not limited to those of the above working example.

As has been discussed, with the invention, heat exchange air ventilation and normal air ventilation are automatically switched between according to the difference between the indoor and outdoor air temperatures. Overall, ventilation can be conducted while wasted energy is reduced. The invention is very advantageous in terms of energy conservation.

Furthermore, switching to low-speed blower operation when air is being taken in and expelled during normal ventilation makes the invention more advantageous because the necessary amount of air is exchanged while the amount of electrical power consumed by the blowers is reduced.

4. Brief Description of the Drawings

Figure 1 is an abbreviated compositional diagram of the ventilating fan of the invention. Figure 2 is a cross-sectional diagram showing the passage switching means. Figure 3 is a diagram of the electrical circuit.

3–6: passages
7–12: ventilation holes
13: heat exchanger
14–15: blowers
16: passage switching means
17: shutter
24, 25: solenoids
26: motor
28: indoor-side temperature sensor
29: outdoor-side temperature sensor

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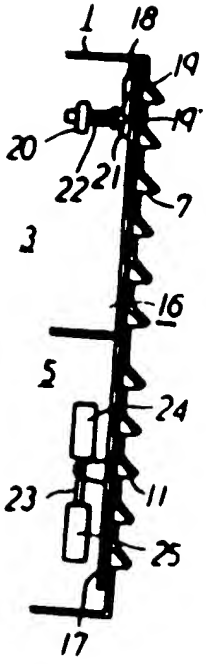

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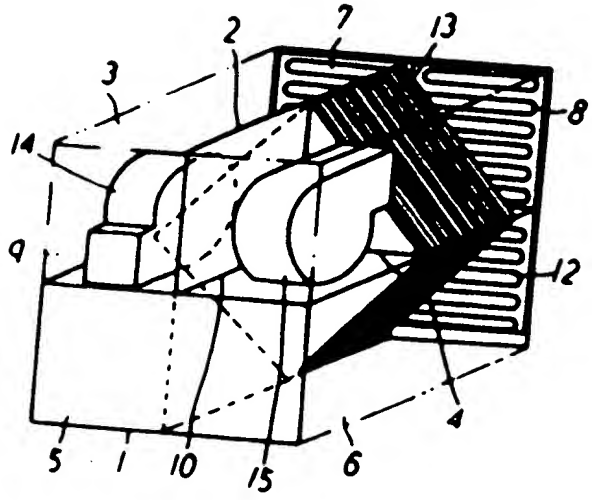

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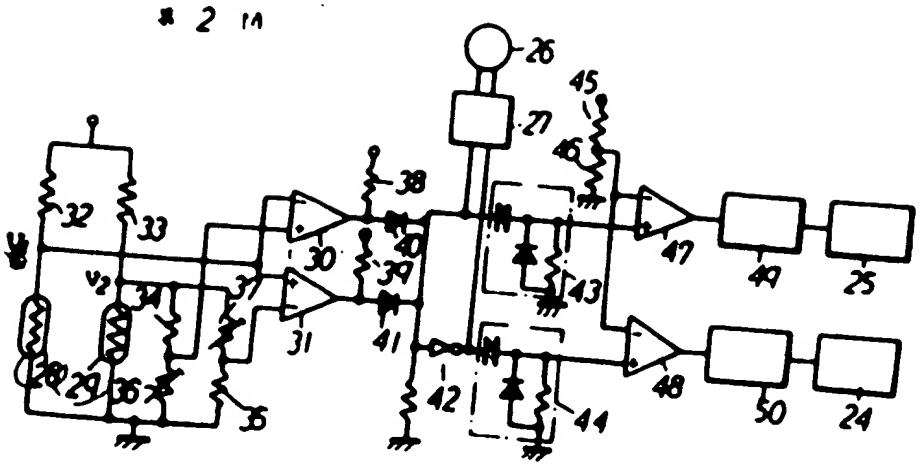

Фиг. 3